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(54) HEAT SYSTEM FOR DISHWASHER

(71) We, THE TAPPAN COMPANY, a corporation organised and existing under the laws of the State of Ohio, United States of America, of Tappan Park Mansfield, Ohio, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to dishwasher apparatus.

Conventional dishwasher configurations employ an electric resistance heating element as a source of power for elevating the temperature of the wash water and for aiding the drying portion of the cycle, such element consisting of a heater coil insulatively supported in the bottom of the dishwasher enclosure, requiring interconnection with the timing mechanism and provision for suitable interconnection wires and the like. A conventional electric motor is employed solely for pumping purposes typically being mounted outside the dishwasher housing and communicating with an impeller arrangement associated with the sump section, developing current losses in the windings and eddy current and the like losses in the core structure which heat energy is merely lost outside the dishwasher housing. Further the externally mounted motor arrangement is a source of malfunction inasmuch as a fluid seal must be established about a rotating member.

According to the present invention there is provided a dishwasher apparatus including a tub and fluid distributing means in the bottom portion thereof, a sump at the mottom of the tube, an electric motor mounted in spaced relation within said sump which generates appreciable heat in the operation thereof, said motor comprising a rotor having fluid flow passages therethrough and a stator, first passage defining means providing directed fluid communication between the tub and that part of the sump containing said rotor, impeller means drivingly connected to the rotor and receiving therefrom fluid from the tub after the same passes through said rotor, said impeller means forcibly delivering the fluid therefrom to an annular space within the sump about the motor, and second passage defining means providing directed communication between said annular space through but separated from said first passage defining means to the fluid distributing means for discharge by the latter into the tub, the arrangement being such that in use the motor generated heat raises the temperature of the fluid thus circulated from the tub through and over said motor sufficient to raise fluid temperature by heat exchange therewith to working temperature in the dishwasher.

According to the present invention in another aspect there is provided a dishwasher having a tub and fluid distributing means therein, a sump at the bottom of the tub, an impeller in said sump for delivering fluid under pressure to said distributing means, an electric motor for driving said impeller and constructed to generate appreciable heat in the operation thereof, a major heat-generating part of said electric motor being sealed within a housing, liquid dielectric substantially filling said housing and conducting heat thereto from the motor part contained therewithin, and passage means for conveying fluid from the tub to the impeller means, said passage means including the exterior of said housing to extract heat from the latter and significantly raise the temperature of the fluid.

When utilizing the motor however for elevation of the wash water temperature different problems are encountered. The

working temperature of the water is significantly dependent in part upon the temperature of the water entering the dishwasher; the rate of elevation of the temperature is of importance in achieving a suitable level during the dishwasher cycle; and consideration must be given to maintenance of the temperature at such elevated level for a predetermined interval of time to assure an optimum cleansing and sanitizing function. It has been learned that when such dual purpose of the motor is required consideration must be given to the type and configuration of motor employed and compromises must be resolved between pumping power and the generation of heating energy. An efficient utilization of such energy must be obtained and requiring design configurations different from the conventional air cooled type of motor arrangement.

Two embodiments of the invention will now be described, by way of examples, with reference to the accompanying drawings, in which:—

Figure 1 is an elevational view in cross-section of the lower portion of a dishwasher enclosure at the sump location;

Figure 2 is a section taken along the lines 2-2 indicated in Figure 1; and

Figure 3 is a partial cross-sectional view of a portion of the lower section of the dishwasher enclosure showing a second embodiment of motor construction employing an oil filled jacket surrounding the stator windings.

Referring now to Figures 1 and 2 there is shown the lower part of a dishwasher 10 embodying the present invention. The dishwasher 10 has a tub 11 forming the dishwasher enclosure and a sump 12. The sump 12 comprises a pan-like housing supported in an opening provided in the bottom of the tub 11 on a flanged adaptor ring 14, the latter being supported in an annular gasket 15 sealingly engaging a depressed section of the tub 11.

A circular bearing plate 16 is secured at the upper portion of the sump 12 such bearing plate 16 having an upstanding bearing housing 18 at the central portion thereof as an integral part. The bearing plate 16 serves to support an electric motor 13 within the sump 12 and forms a part of a separator, indicated generally at 17, separating the sump 12 from the dishwasher enclosure for purposes of directing water flow therebetween. Communication is achieved by a plurality of ports 19 located in the bearing plate 16 just outside the periphery of the bearing housing 18, the water flow being indicated by the dashed arrows 20 in Figure 1.

The bearing plate 16 comprises a further series of outer ports 21 located in a circle outside the inner ports 19, for directing fluid from the sump 12 towards a spray arm mechanism 22 for cleaning purposes. Short lengths of tubing 24 are welded in place on the bearing plate 16 in the outer ports 21 and serve to isolate the fluid flow from that returning from the lower portion of the dishwasher enclosure.

The separator 17 further includes a circular plate 25 having a series of apertures 26 located near the periphery thereof serving as a strainer for the flow of fluid from the dishwasher enclosure. The plate 25 is apertured to fit over the lengths of tubing 24 and the bearing housing 18 and is seated on a flange portion of the bearing housing 18 to provide a separation from the bearing plate 16. The circular plate 25 is secured at its periphery by screws 28 engaging the adaptor ring 14 and forms together with the bearing plate 16 and the tubing 24 disposed therebetween a conduit or crossover path for fluid flow from the dishwasher enclosure to the interior of the motor 13, by way of the drain apertures 26 and the inner series of ports 19, the path for flow of fluid under pressure from the periphery of the motor 13 to the spray arm mechanism 22 being established through the tubing 24.

The spray arm mechanism 22 is for the most part conventional consisting of an apertured conical hood 30 as a support member forming an enclosure for the fluid under pressure, being retained in place by the screws 28 engaging a flange 29 at the lower periphery, such flange 29 lying over the outer edge of the circular plate 25 and having drain apertures 31 therein corresponding to the apertures 26 in the circular plate. An apertured support member 32 is fixed to the top portion of the hood 30 providing support for and communication with an apertured arbor 33 for the spray arm 34, the latter being mounted on the arbor 33 for rotation thereabout under the impetus of the fluid under pressure, being retained in place by cap 35.

In this embodiment of the invention the power source for elevating the temperature of the fluid and supplying pressure thereto is a shaded pole type of induction motor 13 located within the sump 12 and isolated from the dishwasher enclosure formed by tub 11 and the fluid pressure enclosure formed by hood 30, by the separator 17. The motor 13 consists of a stator 36 supported in an upper annular retainer 38 having a flange secured to the lower portion of the bearing plate 16 just outside the circle of inner ports 19. A lower annular member 39 with flange 40 is supported by stator 36 near the bottom of the sump, forming an enclosed path for fluid flow through the interior of the motor 13. The stator 36 con-

sists of an iron core ring formed of stacked laminations having a pair of salient poles thereon which poles are circumscribed by windings 41 interconnected in a conventional manner for single phase power energization, such input power being received via conductors 42 passing through the sump 12 in a fluid tight connector. As is conventional the shaded pole motor 13 includes a shading coil (not shown) consisting of a short circuited turn of copper to cause a flux lag in the shaded portion and as a result, a rotating magnetic field for production of starting torque. The windings 41 and the poles of the stator 36 are encapsulated in an epoxy potting compound 44 leaving the periphery of the stator 36 exposed. Alternatively the stator 36, except for the periphery thereof, may be enclosed in a canister as indicated in dashed lines 45 for additional protection. Significantly however the periphery of the stator 36 extends to a location adjacent the sump 12 in the path of fluid directed about the exterior of the motor 13 upward toward the spray arm mechanism 22. The laminations of the stator 36 thus are in direct contact with the fluid and an effective transferral of the heat developed in the stator 36 may be realised.

The rotor 46 of the motor 13 is centrally oriented within the sump 12 and the stator 36 and consists of a circular core 48 of stacked laminations mounted on a motor shaft 49, in turn supported for rotation within the bearing housing 18 in a dual ball bearing 50 arrangement. The motor shaft 49 is retained by a snap ring 51, the separation of the bearings 50 by a spool 52, with the space therein being filled with lubricant and/or plastics so as to exclude air, while the complete structure is secured by a bearing retainer 54 engaging the lower bearing of the assembly and secured by means of bolts 55 entering the bearing housing 18. The lower portion of the bearing retainer 54 provides freeedom for rotation of the shaft 49 and is closely spaced therefrom to prevent the entrance of liquids to the bearing housing, thereby providing an air space below the lower bearing 50. The core 48 of the rotor 46 includes a plurality of generally axial apertures 56 extending through the laminations adjacent the shaft 49 in the centre of the core 48 to provide a path for the flow of fluid through the interior of the motor 13. Preferably the apertures 56 are angled with respect to the vertical and are sufficiently wide to provide little restriction to the flow of fluid.

Also secured on the underside of the rotor 46 for rotation therewith is an impeller 58 consisting of a thin housing having a plurality of impeller blades 59 welded or formed on the interior thereof. The upper portion of the impeller 58 is apertured to conform with the apertures 56 in the rotor 46 for receipt of fluid therefrom and is secured to the rotor by means of a central bolt 60. The lower portion of the impeller 58 includes a substantially horizontal section 61 extending closely adjacent the lower annular member 39 of the stator 36 to provide a restriction therebetween against the flow of fluid. Upon rotation of the rotor 46, fluid is forced outwardly of the impeller 58 and upwardly over the periphery of the stator 36 to the tubing 24 in the bearing plate 16 and then to the spray arm mechanism 22. The restriction at the bottom of the stator 36 prevents substantial fluid leakage without requiring a seal thereby allowing sufficient pressure to build up for elevation of the fluid to the spray arm mechanism 22. A drain outlet 62 is indicated at the lower portion of the sump 12, most conveniently being solenoid actuated for closure during the pumping cycle and when open a quick evacuation of the sump and dishwasher enclosure.

It is significant to note that relatively thick laminations are indicated in both the stator 36 and rotor 46 of the motor 13 inasmuch as optimum pumping efficiency of the motor is not the sole criterion but rather a compromise between the same and the thermal energy generated so that both functions may be accomplished in the most efficient manner. Thus this form of structure is designed to introduce relatively high levels of eddy current flow and hysteresis loss within the iron structure of the motor 13 and this combined with I^2R loss in the windings 41, which may be controlled in a known manner, can supply sufficient thermal energy for elevating the temperature of the fluid to a desired level. The fluid both within and outside the motor 13 is in direct contact with the epoxy potting compound 44 encapsulating the motor windings 41 so that an optimum heat transferral relation can be achieved.

While the shaded pole type of induction motor of either the two or four pole variety is useful as a part of the apparatus of the invention it will be clear that other types of motor configurations as well can be utilized as the source of power. For example the split phase type of induction motor would be well suited to this purpose providing the similar advantages that such type of motor is operable from the conventional single phase source of power, does not require the inclusion of mechanical switching devices and the like, and is capable of design modification in the manner described to provide a sufficient source of thermal energy. Further

the split phase motor is inherently more efficient than the shaded pole type and allows considerable variations in starting and running characteristics.

A preferred embodiment of the invention is depicted in Figure 3 showing an oil filled jacket 64 enclosing the stator 65 for transferral of heat to circulating fluid both internally and externally of the motor 66. In this figure a split phase type of motor 66 is depicted comprising an annular stator 65 formed of stacked laminations with indicated stator windings 68 disposed thereabout. The stator 65 is disposed within an hermetically sealed annular jacket 64 having thin metal cylindrical outer and inner walls 69, 70 of different diameter and top and bottom walls 71, 72 of metal rings. The entire jacket 64 is secured to and depends from the bearing plate 74 between inner ports 75 and tubes 76 disposed therein in a configuration similar to that previously described.

The jacket 64 is preferably substantially filled with transformer oil 78 which acts as an efficient heat transfer medium and an air space 79 is left at the top thereof. Other types of heat-conductive fluid (liquid dielectric) may be used in place of the oil 78. The jacket 64 is preferably formed of non-magnetic stainless steel and it is desired that the inner wall 70 thereof be thin. It is noted in Figure 3 that the inner wall 70 of the jacket is disposed in the air gap between the rotor 80 and stator 65 thereby requiring a somewhat larger air gap than is conventional. Such form of construction however is useful in that the less efficient motor produces greater thermal energy for elevation of temperature of the fluid and it will be clear to those skilled in the art how motor designs can be further varied to achieve an optimum relation between generation of thermal energy and production of mechanical force for the pumping operation. While many different types of impeller 81 can be utilized within the teachings of this invention it will again be noted that a relatively close spacing is effected between the impeller 81 and the lower wall 72 of the jacket 64 forming a restriction against the flow of fluid therebetween, this being a parameter which affects pumping efficiency and thus heat transferral characteristics of the motor 66.

While the elevation of temperature of wash water is of primary significance, it will be clear that when the dishwasher is evacuated of water a heating effect occurs upon the air therein if the motor 66 is energized, which may assist in the drying cycle of operation, the impeller 81 in this instance serving to circulate air throughout the dishwasher enclosure. Further although a less than optimal design of motor is employed from the standpoint of mechanical efficiency, it will be apparent that overall efficiencies in the cost and operation of the dishwasher can be enhanced both by the elimination of the requirement for a separate heater element and in the less stringent requirements for design of the motor.

Comparative tests between a conventional dishwasher heating system using 750 W heating element and pump motor combination and a dishwasher according to the present invention using a split phase type of motor with an oil-jacketed stator indicate that substantially higher rates of heat rise of washing fluid can be obtained in the dishwasher apparatus of the present invention for equal quantities of input power. Fluid temperatures suitable for washing and drying purposes are readily achieved and maintained even though it is expected, with the dishwasher apparatus according to the present invention, that are somewhat higher than a conventional dishwasher. An optimum range of fluid temperature is expected to fall between 145° and 165°F with desired cleaning temperature attained in 10-15 minutes.

WHAT WE CLAIM IS:—

1. A dishwasher apparatus including a tub and fluid distributing means in the bottom portion thereof, a sump at the bottom of the tub, an electric motor mounted in spaced relation within said sump which generates appreciable heat in the operation thereof, said motor comprising a rotor having fluid flow passages therethrough and a stator, first passage defining means providing directed fluid communication between the tub and that part of the sump containing said rotor, impeller means drivingly connected to the rotor and receiving therefrom fluid from the tub after the same passes through said rotor, said impeller means forcibly delivering the fluid therefrom to an annular space within the sump about the motor, and second passage defining means providing directed communication between said annular space through but separated from said first passage defining means to the fluid distributing means for discharge by the latter into the tub, the arrangement being such that, in use, the motor generated heat raises the temperature of the fluid thus circulated from the tub through and over said motor sufficient to raise the temperature of the fluid by heat exchange therewith to working temperature in the dishwasher.

2. Apparatus as claimed in claim 1, in which said motor is of the induction type having a stator in heat transfer relationship with the fluid.

3. Apparatus as claimed in claim 2, in which said stator of said motor comprises

an encapsulation jacket, said jacket being substantially filled with a heat-conductive liquid for heat transfer to the fluid.

4. Apparatus as claimed in claim 3, in which the windings of said stator are encapsulated in plastics, said stator and said plastics being in heat transferral contact with the fluid.

5. Apparatus as claimed in any preceding claim, in which said motor is of the split phase type.

6. Apparatus as claimed in any one of claims 1 to 4, in which said motor is of the shaded pole type.

7. A dishwasher as claimed in claim 1, in which said motor is of the induction type having a stator fixedly supported and a rotor supported for rotation within said stator, said rotor further supporting said impeller means for rotation therewith.

8. A dishwasher as claimed in claim 7, in which said stator includes windings thereon energisable from a source of power, said windings being encapsulated in epoxy for heat transferral contact with the fluid.

9. A dishwasher as claimed in claim 7 or claim 8, in which an annular housing is supported from said tub, said housing in turn supporting said stator and being substantially filled with oil for transmitting heat from said stator to the fluid.

10. A dishwasher as claimed in claim 9, in which said stator and said rotor comprise stacks of laminations of a thickness sufficient to encourage eddy current losses.

11. A dishwasher as claimed in any one of claims 7 to 10, in which said impeller means comprses a housing having impeller blades therein, said housing being closely spaced from said stator housing to provide a restriction against the flow of fluid therebetween.

12. A dishwasher having a tub and fluid distributing means therein, a sump at the bottom of the tub, an impeller in said sump for delivering fluid under pressure to said distributing means, an electric motor for driving said impeller and constructed to generate appreciable heat in the operation thereof, a major heat-generating part of said electric motor being sealed within a housing, liquid dielectric substantially filling said housing and conducting heat thereto from the motor part contained therewithin, and passage means for conveying fluid from the tub to the impeller means, said passage means including the exterior of said housing to extract heat from the latter and significantly raise the temperature of the fluid.

13. A dishwasher apparatus substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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1 406 155 COMPLETE SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale.

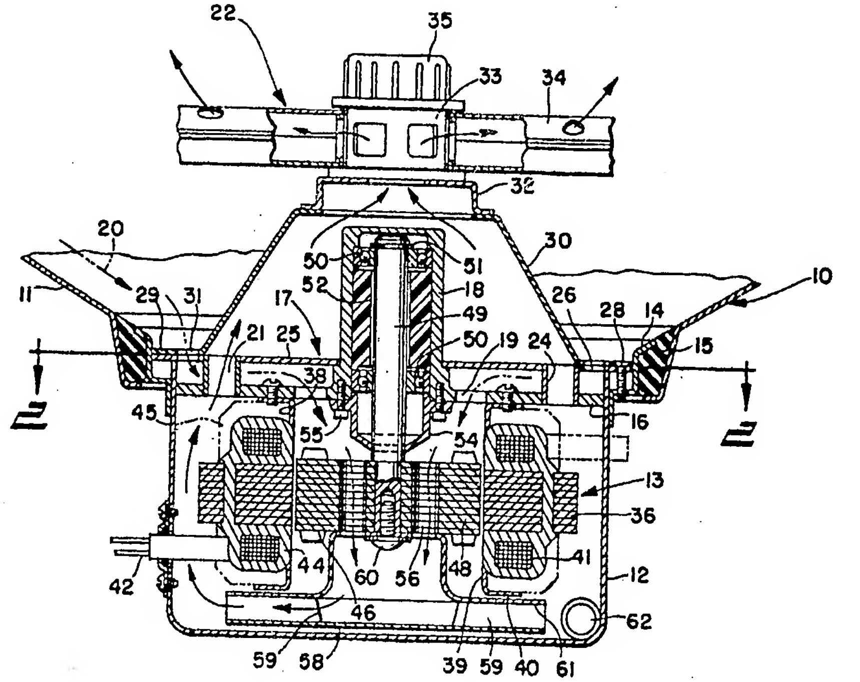

Fig. 1

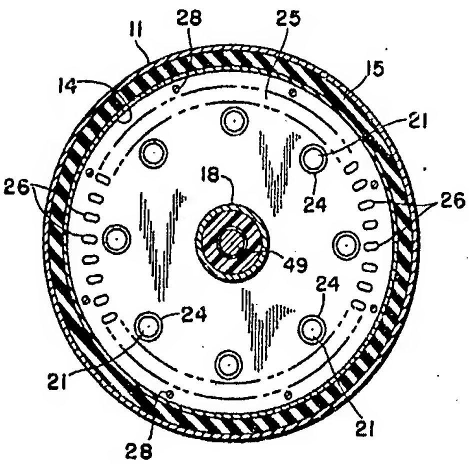

Fig. 2

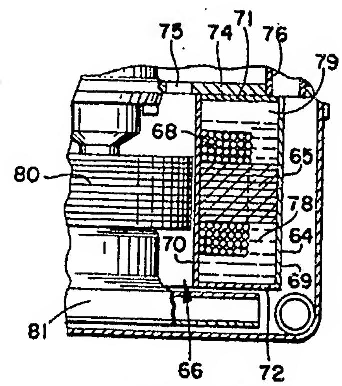

Fig. 3